THAT WHICH IS CLAIMED:

1. A semiconductor device comprising:

a semiconductor substrate;

a first oxide layer on the semiconductor substrate, the first oxide layer comprising an element from the semiconductor substrate;

a second oxide layer on the first oxide layer opposite the semiconductor substrate, the second oxide layer comprising a stoichiometric, single-phase complex oxide represented by the formula:

$$A_hB_jO_k, \text{ or equivalently } (A_mO_n)_a(B_qO_r)_b$$

in which the elemental oxide components, (A_mO_n) and (B_qO_r) are combined so that $h = j$ or, equivalently, $ma = bq$, and a, b, h, j, k, m, n, q and r are non-zero integers; and wherein:

A is an element of the lanthanide rare earth elements of the periodic table or the trivalent elements from cerium to lutetium; and

B is an element of the transition metal elements of groups IIIB, IVB or VB of the periodic table.

2. A device according to Claim 1 wherein the second oxide layer has a thickness of less than 15 nm.

3. A device according to Claim 1 wherein the second oxide layer has a band gap of greater than about 5.5 eV.

4. A device according to Claim 1 wherein the second oxide layer has a conduction band offset energy of greater than 1.5 eV.

5. A device according to Claim 1 wherein the second oxide layer has an equivalent oxide thickness (EOT) of about 0.5 to about 1.6 nm.

6. A device according to Claim 1 wherein B is an element with 3d, 4d or 5d electrons available for bonding to oxygen, and wherein A is an element in which one 5d electron is available for bonding.

7. A device according to Claim 1, wherein B is scandium, titanium, tantalum or niobium.

8. A device according to Claim 1, wherein B is scandium, titanium, tantalum, or niobium (Nb) and wherein A is trivalent gadolinum, praseodynium or lutetium.

9. A device according to Claim 1, wherein B is scandium, titanium, tantalum or niobium and wherein A is cerium, nedoymnium, promethium, samarium, europium, terbium, dysprosium, holmium, erbium, thulium, or ytterbium.

10. A device according to Claim 1, wherein the substrate comprises a material selected from the group consisting of a Group III-V binary alloy, a Group III-V quaternary alloy, a Group III-nitride alloy, and combinations thereof.

11. A device according to Claim 1, wherein the substrate comprises a Group III-V binary alloy selected from the group consisting of (Ga,Al)As, (In,Ga)As, and combinations thereof.

12. A device according to Claim 1, wherein the substrate comprises a Group III-V quaternary alloy comprising (Ga,In)(As,P).

13. A device according to Claim 1, wherein the substrate comprises a Group III-nitride alloy selected from the group consisting of (Ga,Al)N, (Ga,In)N, (Al,In)N, (Ga,Al,In)N, and combinations thereof.

14. A device according to Claim 1, wherein the substrate comprises a material selected from the group consisting of silicon (Si), germanium (Ge), silicon carbide (SiC), gallium nitride (GaN), gallium arsenide (GaAs), and combinations thereof.

15. A device according to Claim 1, wherein the substrate is a semiconductor-on-insulator (SOI) substrate.

16. A device according to Claim 1, wherein the first oxide layer comprises a nitrided silicon dioxide.

17. A device according to Claim 16, wherein the first oxide layer contributes less than about 0.5 nm of oxide-equivalent capacitance to said field effect transistor.

18. A device according to Claim 1, wherein the device comprises a field effect transistor.

19. A device according to Claim 1, wherein the device comprises a photovoltaic device.

20. A device according to Claim 1, wherein the device comprises a high electron mobility transistor.

21. A method of forming a semiconductor device comprising:

providing a semiconductor substrate;

forming a first oxide layer on the semiconductor substrate.

forming a second oxide layer on the first oxide layer opposite the semiconductor substrate, the second oxide layer comprising a stoichiometric, single-phase, complex oxide represented by the formula:

$$A_hB_jO_k\text{, or equivalently } (A_mO_n)_a(B_qO_r)_b$$

in which the elemental oxide components, (A_mO_n) and (B_qO_r) are combined so that $h = j$ or, equivalently, $ma = bq$, and a, b, h, j, k, m, n, q and r are non-zero integers; and wherein:

A is an element of the lanthanide rare earth elements of the periodic table or the trivalent elements from cerium to lutetium; and

B is an element of the transition metal elements of groups IIIB, IVB or VB of the periodic table.

22. A method according to Claim 21, further comprising:

exposing the substrate to one or more gaseous sources comprising elements A, B, and oxygen such that one or more gaseous sources react to form the second oxide layer.

23. A method according to Claim 22, wherein the one or more gaseous sources comprise an amount of oxygen sufficient to substantially oxidize elements A and B.

24. A method according to Claim 21, wherein the step of forming a second oxide layer is performed by a remote plasma-enhanced chemical vapor deposition process.

25. A method according to Claim 24, further comprising:

exposing a gaseous source comprising oxygen and a rare-gas element to radio-frequency plasma-excitation or microwave frequency plasma-excitation;

combining the gaseous source comprising oxygen and a rare-gas element with a gaseous source comprising element A and element B; and

exposing the substrate to the combined gaseous source.

26. A method according to Claim 25, wherein the rare gas element is selected from the group consisting of argon and helium.

27. A method according to Claim 21, wherein B is an element with 3d, 4d or 5d electrons available for bonding to oxygen, and wherein A is an element in which one 5d electron is available for bonding as in trivalent ions.

28. A method according to Claim 21, wherein B is either scandium, titanium, tantalum or niobium.

29. A method according to Claim 21, wherein the step of forming a second oxide layer is performed by an atomic layer absorption process.

30. A method according to Claim 21, wherein the device comprises a field effect transistor.

31. A method according to Claim 21, wherein the device comprises a photovoltaic device.

32. A method according to Claim 21, wherein the device comprises a high electron mobility transistor.